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MEMORANDUM DRAFT

SUBJECT: Idaho Phosphate Slag Usage Implications

FROM: Jerry Leitch
Rad Representative

TO: Gary L. O'Neal, Director
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This is a short review of potential implications of the past and current phosphate slag use practices in south-eastern Idaho. The calculations have not been reviewed, and should not be used to make policy decisions. No large conservative assumptions are made in the calculations, and they represent best estimates of exposure and risk, rather than upper bounds.

The ore used in the manufacturing of phosphorus and phosphate contains an unusual concentration of naturally occurring uranium and it's decay products, including radium, radon, and radon progeny. During processing, one of the radon progeny, polonium-210, is emitted as a stack gas component. It is regulated under the NESHAP rules, and its radiological implications are being studied under the Idaho Radiological Survey.

The balance of the radioactive elements show up in the slag. The radon gas component is immobilized in the matrix of the slag and is not a large problem. There is a penetrating gamma radiation component associated with the slag. Slag causes a whole-body exposure which is rather easily measured. The major uncertainties in exposure are due to assumptions about proximity to the slag. Due to a scarcity of natural aggregate materials, slag has been used extensively for such construction purposes as aggregate in concrete and asphalt, roadbed fill, backfill, railroad ballast, and stabilization material for stock yards. From 1962 until its prohibition in 1977, it was used as aggregate in concrete foundations of houses. It is still widely used in asphalt. Between 50 and 200 homes contain slag. Most of the city streets of Pocatello and Soda Springs contain slag.

Natural background radiation originates from naturally-occurring radio-active elements present in the earth (terrestrial radiation) and radiation entering the earth's atmosphere from space (cosmic radiation).

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DRAFT 1.1.1

DRAFT

Radiological dose due to cosmic radiation varries with altitude and latitude. Typical values in this area of Idaho are about 6 micro-rem per hour. Values in other areas range from 3 micro-rem per hour in Florida to 12 at 10,000 ft. in Colorado.

Terrestrial gamma radiation originates primarily from the uranium and thorium decay chains and radioactive potassium. The natural terrestrial radiation levels depend upon the type of soil and bedrock below. Local concentrations produce dose rates from 1 to 20 micro-rem per hour. Rates on the gulf coast are about 2. The range on the Colorado Plateau is about 10 to 20, and the rest of the country is about 5, with a range of 4 to 9. In this area, terrestrial is about 6 micro-rem per hour.

Terrestrial plus cosmic sums to 12(+/-2) micro-rem per hour. This is an annual dose of 100 milli-rem. This translates to a lifetime risk of a radiogenic fatal cancer of $3x10^{-3}$, due to the natural, undisturbed background. This risk calculation uses a coefficient of 400 fatal cancers per 10^6 rem. This value has been proposed for use by the Science Advisory Board for such calculations. 400 is used throughout this report. The agency used 280 in the past. Other man-caused environmental exposures would be about 10 milli-rem per year. Medical x-rays are about 100. Indoor radon in this area is about 1,000 milli-rem per year dose equivalent.

Radiation workers are permitted 5,000 milli-rem per year maximum dose. The dose to any individual in the general public, from all sources other than natural and medical x-rays, should be limited to 500 milli-rem. The dose to a group of individuals should be limited to less than 170 milli-rem per year, largely based on genetic considerations.

Asphalt which contains slag reads about 30 micro-rem per hour over background. Reasonable assumptions for occupational exposure would be 4 hours per day, five days per week, 50 weeks per year. This would yield an annual dose of 30 millirem. If you assume a 50 year working life, a person would receive 1,500 milli-rem. This translates to a lifetime risk of $6x10^{-4}$.

Slag containing homes were surveyed in 1979. There is a distribution of gamma fields in slag homes that would yield doses ranging from 0 to 40 micro-rem per hour. A reasonable average based on the published distribution would be 20 over background. Assuming 0.75 occupancy, 365 days per year, an occupant would receive 130 milli-rem per year. In a 70 year lifetime, this would yield a $4x10^{-3}$ risk.

40 CFR 192.12(b)(2) is not directly applicable, but can serve to compare the house doses. It states that gamma radiation shall not exceed background by more than 20 micro-roentgens per hour (yielding 20 micro-rem), as a result of residual radioactivity due to inactive uranium processing sites.

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By radiological standards, the doses due to asphalt are not trivial, but they may be acceptable. The first principle is to keep doses as low as reasonably achievable. It could, however, be argued that the exposure is justified by the practical advantage of the material for paving. The doses incurred by those in some slag containing homes is considerable.

The risks due to asphalt paving or slag containing homes would be those calculated under superfund. They may be considered large or extremely large. The precedence for superfund intervention in radiological risks should be reviewed.

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